

-1-

5

PCT Article 34 amendment

Submitted on April 30, 2004

(replacement pages)

10

In this PCT Article 34 amendment, the following changes were made:

- 15 (1) Claim 1 was amended by incorporating the subject matter of claim 4.
- (2) Claims 2-4 were cancelled.
- (3) In Claim 24, the term "Item 1" was amended to read "claim 1".

Thus, Claims 5-23 were not amended.

20

107524843

DTDS Rec'd PCT/PTO 17 FEB 2005

-1-

ART 34 AMDT

5

PCT Article 34 amendment

Submitted on April 30, 2004
(marked up version)

10

In this PCT Article 34 amendment, the following changes were made:

- (1) Claim 1 was amended by incorporating the subject matter of claim 4.
- (2) Claims 2-4 were cancelled.
- (3) In Claim 24, the term "Item 1" was amended to read "claim 1".

Thus, Claims 5-23 were not amended.

20

CLAIMS

1. (Amended) A lubricating oil for bearings comprising
(a) a diester represented by General Formula (1)



5 wherein R^1 and R^2 are the same or different, and each represents a C_3-C_{17} linear alkyl group; A represents a C_2-C_{10} linear alkylene group or A represents a branched alkylene group consisting of a linear alkylene group, the linear alkylene group being the principal chain,
10 and one or more alkyl groups (branches) bonded to the linear alkylene group, wherein the total number of carbon atoms of said linear alkylene group and said one or more alkyl groups is 2 to 10; with the proviso that when A is a branched alkylene group and has two or more alkyl groups, the two or more alkyl groups are not bonded
15 to the same carbon atom; a monoalkyl substituted linear alkylene group, and the total number of carbon atoms of the alkyl group and the linear alkylene group is 4 to 6; or a mixture of the diester and an additional base oil, and

20 (b) at least one member selected from the group consisting of phenol-based antioxidants and amine-based antioxidants.

25 2. (Cancelled) A lubricating oil for bearings according to Claim 1, wherein A represents a mono- or poly-alkyl substituted linear alkylene group in which the total number of carbon atoms of the alkyl group and the linear alkylene group is 3 to 10.

30 3. (Cancelled) A lubricating oil for bearings according to Claim 1, wherein A represents a monoalkyl substituted linear alkylene group in which the total number of carbon atoms of the alkyl group and the linear alkylene group is 3 to 10.

4. (Cancelled) A lubricating oil for bearings according to Claim 1,

wherein A represents a monoalkyl substituted linear alkylene group, and the total number of carbon atoms of the alkyl group and the linear alkylene group is 4 to 6.

- 5 5. A lubricating oil for bearings according to Claim 1, wherein A is a 3-methyl-1,5-pentanediol residue (i.e.,
-CH₂CH₂-CH(CH₃)-CH₂CH₂-).
- 10 6. A lubricating oil for bearings according to Claim 1, wherein R¹ and R² are the same or different, and each represents a C₃-C₁₁ linear alkyl group.
- 15 7. A lubricating oil for bearings according to Claim 1, wherein the diester represented by General Formula (1) is a diester of a member selected from the group consisting of 2-methyl-1,3-propanediol, 1,3-butanediol, 2-methyl-1,4-butanediol, 1,4-pantanediol, 2-methyl-1,5-pantanediol, 3-methyl-1,5-pantanediol and 1,5-hexanediol and a member selected from C₇-C₁₀ saturated aliphatic linear monocarboxylic acids.
- 20 8. A lubricating oil for bearings according to Claim 1, wherein the diester represented by General Formula (1) is a diester obtained from 3-methyl-1,5-pantanediol, and at least one member selected from the group consisting of n-heptanoic acid, n-octanoic acid, n-nonanoic acid and n-decanoic acid.
- 25 9. A lubricating oil for bearings according to Claim 1, wherein the diester represented by General Formula (1) is at least one member selected from the group consisting of 3-methyl-1,5-pantanediol di(n-octanoate) and 3-methyl-1,5-pantanediol di(n-nonanoate).
- 30 10. A lubricating oil for bearings according to Claim 1, wherein the diester represented by General Formula (1) is a diester obtained from two kinds of fatty acids selected from C₇-C₁₀ saturated aliphatic linear monocarboxylic acids, and one kind of dihydric alcohol

ART 34 AMDT

selected from the group consisting of 2-methyl-1,3-propanediol, 1,3-butanediol, 2-methyl-1,4-butanediol, 1,4-pantanediol, 2-methyl-1,5-pantanediol, 3-methyl-1,5-pantanediol and 1,5-hexanediol.

5

11. A lubricating oil for bearings according to Claim 1, wherein the diester represented by General Formula (1) is a diester obtained from 3-methyl-1,5-pantanediol and two kinds of fatty acids selected from saturated aliphatic linear monocarboxylic acids having 7 to 10 carbon atoms.

12. A lubricating oil for bearings according to Claim 1, wherein the diester represented by General Formula (1) is a diester prepared from 3-methyl-1,5-pantanediol and n-heptanoic acid and n-octanoic acid, a diester prepared from 3-methyl-1,5-pantanediol and n-heptanoic acid and n-nonanoic acid, a diester prepared from 3-methyl-1,5-pantanediol and n-heptanoic acid and n-decanoic acid, a diester prepared from 3-methyl-1,5-pantanediol and n-octanoic acid and n-nonanoic acid, a diester prepared from 3-methyl-1,5-pantanediol and n-octanoic acid and n-decanoic acid, a diester prepared from 3-methyl-1,5-pantanediol and n-nonanoic acid and n-decanoic acid.

13. A lubricating oil for bearings according to Claim 1, wherein the phenol-based antioxidant has 6 to 100 carbon atoms and contains no sulfur atoms in the molecule, and the amine-based antioxidant has 6 to 60 carbon atoms and contains no sulfur atoms in the molecule.

14. A lubricating oil for bearings according to Claim 13, wherein the phenol-based antioxidant is at least one member selected from the group consisting of 2,6-di-t-butylphenol, 2,6-di-t-butyl-p-cresol, 4,4'-methylenebis(2,6-di-t-butylphenol), 4,4'-butyldenebis(3-methyl-6-t-butylphenol), 2,2'-methylenebis(4-ethyl-6-t-butylphenol), 35 2,2'-methylenebis(4-methyl-6-t-butylphenol),

- 4,4'-isopropylidenebisphenol, 2,4-dimethyl-6-t-butylphenol, tetrakis [methylene-3-(3,5-di-t-butyl-4-hydroxyphenyl)-propionate]methane,
- 1,1,3-tris(2-methyl-4-hydroxy-5-t-butylphenyl)butane,
- 5 1,3,5-trimethyl-2,4,6-tris(3,5-di-t-butyl-4-hydroxybenzyl)-benzene,
- 2,2'-dihydroxy-3,3'-di(α -methylcyclohexyl)-5,5'-dimethyl-diphenyl methane, 2,2'-isobutylidenebis(4,6-dimethylphenol),
- 2,6-bis(2'-hydroxy-3'-t-butyl-5'-methylbenzyl)-4-methylphenol,
- 10 1,1'-bis(4-hydroxyphenyl)cyclohexane, 2,5-di-t-amylhydroquinone, 2,5-di-t-butylhydroquinone, 1,4-dihydroxyanthraquinone, 3-t-butyl-4-hydroxyanisole, 2-t-butyl-4-hydroxyanisole, 2,4-dibenzoylresorcinol, 4-t-butylcatechol,
- 2,6-di-t-butyl-4-ethylphenol, 2-hydroxy-4-methoxybenzophenone,
- 15 2,4-dihydroxybenzophenone, 2,2'-dihydroxy-4-methoxybenzophenone, 2,4,5-trihydroxybenzophenone, α -tocopherol, bis[2-(2-hydroxy-5-methyl-3-t-butylbenzyl)-4-methyl-6-t-butyl-phenyl]terephthalate,
- triethyleneglycol-bis[3-(3-t-butyl-5-methyl-4-hydroxyphenyl-
20 propionate),
- 1,6-hexanediol-bis[3-(3,5-di-t-butyl-4-hydroxyphenyl)propionate]; and

the amine-based antioxidant is at least one member selected from the group consisting of diphenylamine, mono(C₄-C₉ alkyl)-substituted diphenylamines, p,p'-di(C₄-C₉ alkylphenyl)amines, and di(mono C₄-C₉ alkylphenyl)amines wherein the alkyl group on one benzene ring is different from the alkyl group on the other benzene ring, di(di-C₄-C₉ alkylphenyl)amines wherein at least one of the four alkyl groups on the two benzene rings is different from the other alkyl group(s), N-phenyl-1-naphthylamine, N-phenyl-2-naphthylamine, 4-octylphenyl-1-naphthylamine, 4-octylphenyl-2-naphthylamine, p-phenylenediamine, N-phenyl-N'-isopropyl-p-phenylenediamine, and N-phenyl-N'-(1,3-dimethylbutyl)-p-phenylenediamine.

35 15. A lubricating oil for bearings according to Claim 13, wherein

ART 34 AMDT

component (b) is a combination of at least one member selected from the group consisting of 2,6-di-t-butyl-p-cresol, 4,4'-methylenebis(2,6-di-t-butylphenol) and 2,6-di-t-butyl-4-ethylphenol with at least one member selected from 5 the group consisting of *p,p'*-dioctyl (including linear and branched) diphenylamines, *p,p'*-dinonyl (including linear and branched) diphenylamines, and *N*-phenyl-1-naphthylamine.

16. A lubricating oil for bearings according to Claim 1, which further 10 comprises (c) at least one member selected from the group consisting of phosphorus-based compounds and aliphatic linear monocarboxylic acids.

17. A lubricating oil for bearings according to Claim 16, wherein 15 the phosphorus-based compound is at least one member selected from the group consisting of phosphoric acid triesters, phosphorous acid triesters, acid phosphates and acid phosphites, each having 12 to 70 carbon atoms and containing no sulfur atoms in the molecules, and the aliphatic linear monocarboxylic acid has 12 to 22 carbon atoms.

20 18. A lubricating oil for bearings according to Claim 16, wherein the phosphorus-based compound is at least one member selected from the group consisting of

- c1) tri(linear or branched C₄-C₁₈ alkyl) phosphates,
- 25 c2) tri(C₄-C₈ cycloalkyl) phosphates,
- c3) tri(unsubstituted or substituted phenyl) phosphates (the substituted phenyl group is substituted with 1 to 3 substituents selected from the group consisting of C₁-C₁₀ alkyl, halogen atom (in particular, bromine) and hydroxy group. One or two of the three phenyl groups may be unsubstituted and the rest may be substituted.),
- c4) tri(linear or branched C₄-C₁₈ alkyl) phosphites,
- c5) tri(C₄-C₈ cycloalkyl) phosphites,
- c6) tri(unsubstituted or substituted) phosphites (the substituted phenyl group is substituted with one to three substituents selected 35 from the group consisting of C₁-C₁₀ alkyl, halogen atom (in particular,

- bromine) and hydroxy group. One or two of the three phenyl groups may be unsubstituted and the rest may be substituted.),
- c7) di(linear or branched C₄-C₁₈ alkyl) phosphates,
- c8) di(C₄-C₈ cycloalkyl) phosphates,
- 5 c9) di(unsubstituted or substituted phenyl) phosphates (the substituted phenyl group is substituted with one to three substituents selected from the group consisting of C₁-C₁₀ alkyl, halogen atom (in particular, bromine) and hydroxy group. One of the two phenyl groups may be unsubstituted and the other may be
- 10 substituted.),
- c10) di(linear or branched C₄-C₁₈ alkyl) phosphites,
- c11) di(C₄-C₈ cycloalkyl) phosphites, and
- c12) di(unsubstituted or substituted) phosphites (the substituted phenyl group is substituted with 1 to 3 substituents selected from
- 15 the group consisting of C₁-C₁₀ alkyl, halogen atom (in particular, bromine) and hydroxy group. One of the two phenyl groups may be unsubstituted and the other may be substituted.), and
- the aliphatic linear monocarboxylic acid has 14 to 18 carbon atoms.
- 20
19. A lubricating oil for bearings according to Claim 16, wherein said at least one member selected from the group consisting of phosphorus-based compounds and aliphatic linear monocarboxylic acids is a combination of at least one member selected from the group
- 25 consisting of tri(n-octyl) phosphate, triphenyl phosphate and tricresyl phosphate with at least one member selected from the group consisting of n-tetradecanoic acid, n-hexadecanoic acid and n-octadecanoic acid.
- 30 20. A lubricating oil for bearings according to Claim 16, which further comprises (d) at least one member selected from the group consisting of benzotriazole-based compounds and gallic acid-based compounds.
- 35 21. A lubricating oil for bearings according to Claim 20, wherein

the benzotriazole-based compound has 6 to 60 carbon atoms and contains no sulfur atoms in the molecule, and the gallic acid-based compound has 7 to 30 carbon atoms.

- 5 22. A lubricating oil for bearings according to Claim 20, wherein the benzotriazole-based compound is at least one member selected from the group consisting of benzotriazole, 5-methyl-1H-benzotriazole, 1-dioctylaminomethylbenzotriazole, 1-dioctylaminomethyl-5-methylbenzotriazole,
- 10 2-(5'-methyl-2'-hydroxyenyl)benzotriazole, 2-[2'-hydroxy-3',5'-bis(α, α-dimethylbenzyl)phenyl]-2H-benzotriazole, 2-(3',5'-di-t-butyl-2'-hydroxyphenyl)benzotriazole, 2-(3'-t-butyl-5'-methyl-2'-hydroxyphenyl)-5-chlorobenzotriazole, 2-(3',5'-di-t-butyl-2'-hydroxyphenyl)-5-chlorobenzotriazole,
- 15 2-(3',5'-di-t-amyl-2'-hydroxyphenyl)benzotriazole, 2-(5'-t-butyl-2'-hydroxyphenyl)benzotriazole, 2-(2'-hydroxy-5'-methylphenyl)benzotriazole, 2-(2'-hydroxy-5'-t-octylphenyl)benzotriazole, and 2-[2'-hydroxy-3'-(3'',4''-5'',6''tetrahydrophthalide)methyl]-5'-methylphenyl]benzotriazole; and

the gallic acid-based compound is at least one member selected from the group consisting of gallic acid, linear or branched C₁-C₂₂ alkyl esters of gallic acid and C₄-C₈ cycloalkyl esters of gallic acid.

- 25 23. A lubricating oil for bearings according to Claim 20, wherein said at least one member selected from the group consisting of benzotriazole-based compounds and the gallic acid-based compounds is:

- benzotriazole + (n-propyl) gallate,
- 30 • benzotriazole + (n-octyl) gallate,
- benzotriazole + (n-dodecyl) gallate,
- 5-methyl-1H-benzotriazolebenzotriazole + (n-propyl) gallate,
- 5-methyl-1H-benzotriazole + (n-octyl) gallate, or
- 5-methyl-1H-benzotriazole + (n-dodecyl) gallate.

ART 34 AMDT

-9-

24. (Amended) A lubricating oil for bearings according to ~~Item 1~~
Claim 1, having a kinematic viscosity at 40°C of 5-10 mm²/s and a
kinematic viscosity at 0°C of 15-40 mm²/s.